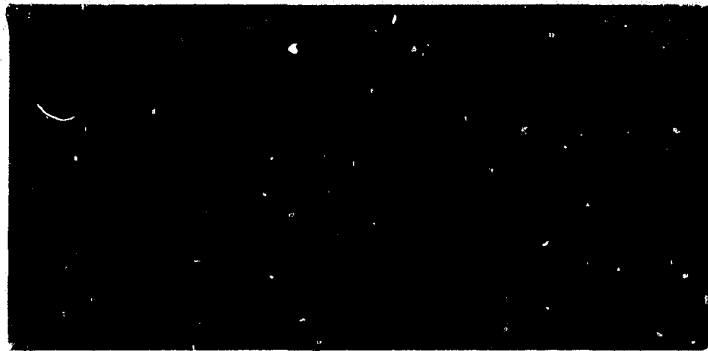


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CONTROLLING URBAN CRIME

by

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James Q. Wilson and Barbara Boland

The high and rising levels of crime during a decade of widespread and generally increasing prosperity have given a greater plausibility and even urgency to efforts to deal with crime, not by eliminating its causes, but by increasing the security of potential victims and by improving the effectiveness of the criminal justice system. Citizens, of course, have long been taking measures to make their homes and persons more secure and the police and others have long argued for changes in the way we handle arrested offenders. But now scholars and public officials, having discovered that it is difficult if not impossible to alter in the short run those social conditions that stimulate crime, are displaying a greater interest in various protective and deterrent techniques.

To understand how great a change this represents, it is only necessary to recall that a decade ago (or less), many writers were arguing that the increase in crime then being reported was either nonexistent or highly questionable owing to defects in the methods by which crime statistics are collected and reported. The Uniform Crime Reports of the FBI are still gathered in about the same way as they were ten years ago, but now scarcely anyone denies that they show a genuine increase in crime. In part this is because so many citizens have been victimized that fewer are inclined to doubt the generality of crime. But there are also reasonable factual grounds for accepting this view. In 1966, the National Opinion Research Center, under contract to the President's Commission on Law Enforcement and Administration of Justice, conducted a survey of ten thousand households to find out how

many had been victimized by crime. It found that just under 32 out of every thousand households had been burglarized in the preceding year. In 1973, the Bureau of the Census, acting under the direction of the Law Enforcement Assistance Administration, again conducted a victimization survey to a larger but somewhat differently drawn sample of households. The Census Bureau found that 94 out of every thousand households had been burglarized, suggesting that the burglary rate had increased by 195 percent during the seven-year period, 1966-1973. (Interestingly enough, the FBI Uniform Crime Reports gave the increase as 108 percent. The actual increase was greater than the reported one.)*

During this period, median personal income, in real dollars, was rising, the proportion of families living below the poverty line was declining, the quality of the housing stock was improving, and expenditures on police protection were growing. A cynic could find in these facts grounds for asserting that efforts to eliminate the presumed causes of crime -- poverty, poor housing, etc. -- and efforts to upgrade the quality of law enforcement have produced, not a decline in crime, but an increase.

Indeed, such a view may not be cynical at all, as there are plausible grounds for expecting this relationship to exist. Improved material standards may in the short run stimulate consumer expectations faster than they can be satisfied leading some, especially the young, to steal more in order to keep pace with those who can afford to buy more. Putting more policemen on the street may conceivably induce people to report, and even to commit, more crime.

In the long term, the apparent positive relationship between rising incomes and rising crime may well prove to be spurious in two senses. In the first

* Comparing the results of the 1966 and the 1973 surveys is difficult. We deal with some of the issues in the Appendix.

place, higher income communities have on the whole less crime than lower income ones, and in the long run a lasting increase in the level of affluence and amenity in a community should contribute to a reduction in crime. But in the second place, it may not be income alone that affects crime. We know that middle-class communities produce less predatory crime than lower-class ones, but "class", insofar as it is related to crime, is not simply a product of income. Middle-class communities also are more likely than lower-class ones to have intact families, a high level of achievement motivation, a concern for the good will and respect of others, and a stronger set of internalized rules and norms about proper behavior. Decent incomes and steady employment may be necessary conditions for the development of such attitudes (though in some cases even that is not clear), but they are far from being sufficient ones.

Furthermore, the effect of prosperity on crime has been confounded by the operation of other important social forces. The prosperity of the 1960s was accompanied, unlike some previous periods of prosperity, by a great increase in the youthful (that is, the crime-prone) component of the population and, though the changed age distribution cannot explain all (or even most) of the crime increase, there is no question it explains some of it. And the past decade has witnessed a vast increase in the level of drug abuse with an unmeasured but probably substantial effect on crime, especially theft. Finally, there was a sharp increase in the proportion of broken homes (i.e., of families with one parent absent).

The theme of this paper is not that these social factors are unimportant or unchangeable, but that since we cannot change them by plan for large numbers of people in any reasonable time period, we must deal with crime by selecting those variables that are subject to change at an acceptable cost

and that if changed will alter significantly the rate at which crime is committed. These variables, it turns out, are those that relate to the personal protection of the citizen, to the physical conditions that prevail in his neighborhood or community, and to the operation of the criminal justice system. They are to a large degree "mechanical" -- that is, they involve constructing facilities, deploying equipment, or making decisions among feasible alternatives. We believe that there is no incompatibility between employing useful crime-reduction techniques, however mechanical, and addressing, by other means, larger social questions of employment, income distribution, family structure, and education. Indeed, we put the matter more strongly: it is hard to imagine how many programs designed to improve education or employment can succeed when certain forms of crime disrupt the operation of schools and offer attractive alternatives to legitimate jobs.

Every survey in recent years has shown that the public ranks crime as a matter of great personal concern. And a majority of the public believes that the main reason why some persons become criminals has to do with some failing in their home life -- a belief that is quite consistent with much, though not all, criminological research. (Joint Commission on Correctional Manpower and Training, p. 5) But as we shall point out later in this paper, it is far from clear what society can do about weak or disorganized families in ways that will reduce their contribution to criminal careers. Most citizens, black and white, believe the police are doing a good job, though young black males are quite critical of them. (Wilson, 1975, chap. 6) Most citizens also believe the courts are "too lenient" in dealing with offenders. (Joint Commission, p. 6) But when asked to what kinds of prisons judges should send offenders, the vast majority -- 84 percent -- believe they should be ones that emphasize "rehabilitation". Interestingly, the higher one's

education, the more one is likely to believe in rehabilitation, and whites are much more likely to believe in it than blacks. (Ibid., p. 7) Citizens are not convinced that prisons have been very successful in rehabilitating offenders (only 5 percent think this), but they seem quite optimistic that it can be done. (Ibid., p. 8) As we shall see, there is little scientific evidence to support that optimism.

It is not surprising that on matters visible to them and salient to their deepest interests the public should have accurate views while on matters, however important, carried on at a distance from them they should have inconsistent or inaccurate beliefs. Thus, it is no cause for wonder that citizens were well ahead of politicians and social scientists in realizing, early in the 1960s, that we were in the midst of a serious and sharp increase in crime rates but no better than politicians and social scientists in devising remedies for that problem.

PREDATORY CRIME

To begin with a serious analysis of crime, we must first make some distinctions. We shall be concerned, as most citizens are concerned, not with all crime, but with predatory crime -- crime committed against innocent victims, usually for financial gain. For the most part we shall look at only one such crime: robbery. It is especially frightening, it often involves violence, and it is quite common. In 1973 about 382,680 robberies were reported to the police, two thirds of them in cities of over 250,000 population. (Uniform Crime Reports, 1973. pp. 15-17) For purposes of analysis it is an interesting crime because, unlike with crimes of stealth, the characteristics of the offender as well as of the victim are usually known.

Some may question our emphasis on only one crime, to the neglect of crime in general. To us, talking about crime "in general" is what requires justification. Crimes differ greatly in their incidence, costs, risks, and prevention, and measures intended to reduce one may have no effect whatsoever on another. Even the crime of robbery is too general a category: one must distinguish among residential robbery (often the unintended result of a burglar finding his victims at home), personal robbery on the street (muggings, holdups, and the like), and commercial robbery. Burglary affects four times as many citizens as robbery and the financial loss in a typical burglary is greater than in a personal street robbery. For these reasons we will devote some attention to burglary. But robbery is the crime that most citizens have in mind when they speak of "crime in the street" -- it occurs to a person, not to an unoccupied house; it involves force or the threat of force; and injuries can result, sometimes serious ones. It is fear of robbery that

induces many citizens to stay home at night and to avoid the streets, thereby diminishing the sense of community and increasing the freedom with which criminals may make the streets their privileged domain. These psychic and communal costs of robbery, impossible to measure, are, we believe, so great as to make it the most costly of all common crimes.

Our measures of the number of robberies and of the characteristics of victims and assailants are taken from the household victimization surveys carried out by the U.S. Bureau of the Census for the Law Enforcement Assistance Administration. These surveys were conducted during late 1972 and early 1973 and 1974 in 26 cities.* In each household, the respondent was asked to list every crime committed against any and every member of that household age 12 and over during the preceding year. (There were also surveys of commercial establishments, but we shall leave these reports out of account).

The definition of robbery employed in these surveys is this:

"Robbery -- Theft and attempted theft, directly from a person or commercial establishment, of property or cash by force or threat of force, with or without a weapon."

Excluded from this definition are thefts from the person involving no force or threat of force, such as purse snatching and pocket picking.

About half of all the robberies reported to the Census Bureau by citizens were said by those citizens also to have been reported to the police. The robberies not reported tended to be the less serious ones: that is, attempted but unsuccessful robberies, robberies without injuries, or robberies involving

* Atlanta, Baltimore, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Houston, Los Angeles, Miami, Milwaukee, Minneapolis, Newark, New Orleans, New York, Oakland, Philadelphia, Pittsburgh, Portland (Oregon), St. Louis, San Diego, Washington, D.C.

minor degrees of assault. The proportion of all robberies said to have been reported to the police ranged from a low of 44 percent in Denver and San Francisco to a high of 65 percent in Miami.

Persons who had been victimized by a robber were asked questions about the criminal's identity -- sex, race, and whether there was one or several perpetrators. In about 95 percent of the robberies information about the perpetrator was obtained. The vast majority of offenders were described as strangers, in about two thirds of the cases there was more than one perpetrator, and almost all offenders were identified as males. The proportion identified as black varied greatly from city to city, reflecting, among other things, the number of blacks living in a city.

Two rates were calculated from these data. The victimization rate is the number of victimizations per thousand population age 12 and over, as of the survey date. When more than one person was victimized in a single incident, each person counts as a separate victimization. Various age-, sex-, and race-specific victimization rates were also calculated: for example, the number of victimizations of black females per thousand black females living in the city. For the 26 cities, @17 per thousand whites and @26 per thousand nonwhites were victimized by robberies.

The offense rate is the number of victimizations committed by persons with a particular characteristic (age, sex, race) per thousand persons with that characteristic in the city. For example, the white offense rate for robbery is the number of victimizations committed by persons observed to be white per thousand white persons in the city. For the 26 cities, 76 percent of the robberies were reported as being committed by nonwhites. The offense rate was @4.8 robberies per thousand whites and @58.6 per thousand nonwhites.

Not all robberies are of equal seriousness. A thirteen year-old boy might be set upon by two bigger boys on the way to school and his lunch money taken away. A sixty-five year-old widow may be threatened with a gun and the entire proceeds of his Social Security check taken. As we shall see, it is possible that in some communities, where robberies are comparatively rare, the lunch money episode will be reported to the police and recalled for the Census interviewers while in another city where robberies are quite common, such an episode will be neither reported nor recalled. We attempt to control for the seriousness of the crime in certain calculations by using a rate of "serious robberies", which we define as those in which more than \$10 was taken.

Victimization rates for robbery vary enormously by place, race, age, sex, and income. In general, the risk of being robbed is greater for blacks than for whites, for the young than for the old, for males than for females, and for the poor rather than for the rich. The riskiest of the 26 cities is Detroit (31 robberies per thousand), the least risky is Miami (9 robberies per thousand). In Detroit, a nonwhite male under the age of 15 has about 9 chances in 100 of being robbed during a given year, which is more than five times the rate at which elderly white females are robbed in that city (1.8 chances per hundred for those over 65).

There are some exceptions to these patterns. In New York City, for example, whites earning over \$25,000 a year are just as likely to be robbed as those earning under \$3,000 and nonwhites in the upper-income brackets are more likely to be robbed than those in the lower ones. This probably reflects the fact that in New York, unlike many other cities, a disproportionate number of affluent persons, white and black, choose to live in the high-risk

central-city areas (i.e., Manhattan) whereas in other cities they would live in a lower-risk periphery.

In general, people in Southern cities are less likely to be robbed than those in Northern ones, even allowing for differences in the social composition of the city. Atlanta is 54 percent and Dallas 26 percent nonwhite, yet the robbery victimization rate in these cities is less than half what it is in Detroit (47 percent nonwhite) or Philadelphia (32 percent nonwhite).

Were we to take into account robberies in places of business, the overall risk rises substantially. For all commercial establishments, 95 out of every thousand were robbed; among only retail establishments, the rate was 189 per thousand. (Adding burglary to the list of offenses increases the risk phenomenally. Assuming no multiple victimizations, over 45 percent of all firms were burgled or robbed during the year preceding the survey).

The rates of victimization are for a single year only. They may be higher or lower in earlier or later years. Assuming, however, that the chances of being robbed remain constant every year for persons in a given group, and assuming that no one is robbed before reaching the age of 12 and lives to age 65, one can calculate the lifetime probability of being robbed. For a black male in New York City, it is 84 chances in one hundred; for a black male in Detroit, it is 92 chances in one hundred.*

*

The probability of being a victim of at least one crime between the ages 12 and 65 is approximately $1 - e^{-54\alpha}$ where α is the crime rate of a given area. For a mathematical derivation see Benjamin Avi-Itzhak and Reuel Shinnar, "Quantitative Models in Crime Control," Journal of Criminal Justice, Vol. 1, 1973.

SELF-DEFENSE

The policy implications of the foregoing are not especially encouraging. A young, poor, black male in Detroit would be well advised to get older, become a woman, turn white, earn a high salary, and move to Miami. How he might go about following that advice is not clear.

And that is the difficulty. Many of the factors most dramatically associated with high victimization rates -- age, sex, race -- are not subject to planned change and a major factor that can be altered -- location -- cannot be changed for large numbers of people without defeating the purpose of the change. Any given person moving from Detroit to Miami will experience a two thirds reduction in his chances of being robbed, but if everyone in Detroit moved, Miami might well acquire Detroit's robbery rate.

Relocation

If movement from city to city is a practical approach to risk-reduction for only a part of the population, what about movement within a city? Everyone is aware, of course, that in any city there seem to be "high crime" areas and many persons move to peripheral or suburban locations in an effort to avoid these areas. Studies many decades ago by the "Chicago school" of sociology suggested that crime and delinquency rates were at their highest in the inner-most parts of a city, decreasing more or less steadily as one moved outward. On the other hand, public attention has recently been directed to the rapid apparent increase in suburban crime rates, leading some to suppose that no metropolitan location is any longer safe.

A crude answer to the question can be obtained from the crime rates calculated by the FBI for cities grouped by size and by suburban or nonsuburban

location. As Table 1 shows, the reported robbery rates are strongly correlated with city size while the burglary breaking-and-entering rates are only weakly correlated with size. Robbery rates for cities of 250,000 to 500,000 population are only about half what they are for cities over 1 million population; burglary rates, on the other hand, are slightly higher for the middle-sized cities than for the very large ones. Burglary rates begin to decline with population for cities smaller than 250,000 but not nearly as steeply as do the robbery rates.

Table 1

Rates of burglaries and robberies, reported to the police, by urban population groups (1973)

<u>Population group</u>	<u>Robbery rate</u>	<u>Burglary rate</u>
6 cities over 1 million pop.	756.2	1850.4
21 cities, 500,000 to 1 million pop.	457.6	1964.1
31 cities, 250,000 to 500,000 pop.	396.9	2101.9
101 cities, 100,000 to 250,000 pop.	236.9	1807.1
264 cities, 50,000 to 100,000 pop.	145.2	1342.4
505 cities, 25,000 to 50,000 pop.	109.3	1138.3
1,271 cities, 10,000 to 25,000 pop.	60.9	965.5

Rate per hundred thousand population

Source: Uniform Crime Reports (FBI), 1973, pp. 104-105.

Among suburban cities (Table 2), the robbery rate also declines with decreases in population -- cities under 10,000 have only half the robbery rate of those 25,000 to 50,000. The burglary rate, on the other hand, seems about the same for all suburban cities whatever their size.

Table 2

Rates of robbery and burglary reported to the police
for suburban cities, by population size (1973)

<u>Population size</u>	<u>Robbery rate</u>	<u>Burglary rate</u>
300 cities, 25,000 to 50,000 pop.	117.3	1102.8
833 cities, 10,000 to 25,000 pop.	64.7	992.6
1,526 cities under 10,000 pop.	51.4	935.5

Rate per hundred thousand population

Source: Uniform Crime Reports (FBI), 1973, p.106.

These aggregate totals conceal, however, a good deal of variation within cities. Repetto, in his detailed analysis of residential burglary and robbery in Boston, compiled crime reports for 39 "Reporting Areas" -- the smallest unit within the city by which police data are collected. (There are 824 such areas in Boston). To check the validity of police reports, a victimization survey was conducted in 18 of these areas. He concluded that the average annual burglary rate (per one thousand dwelling units) was 39 in the innermost part of the city but only 12 in the outlying parts. However, there was also a good deal of variation in burglary rates between adjacent Reporting Areas, suggesting that factors in addition to proximity to the core are also important. Among these are the kinds of dwelling units (whether well-guarded, high-rise apartments

or unguarded detached or duplex houses), the presence of valuable targets (the fashionable Back Bay was more heavily burgled than adjacent, less affluent areas), and the existence of strong community organization (the Italian North End, highly cohesive, was less frequently burgled than more disorganized areas with the same housing and income levels). (Repetto, 34-35, 47-48, 132-133)

In short, residential relocation within a metropolitan area can make a substantial difference in the risk of robbery, even when measured by the most aggregate statistics, and can also make a difference in the risk of burglary provided one chooses the neighborhood with great care.

Relocating oneself within a metropolitan area is obviously a more practical matter than moving across the country. Even so, there are limits to that policy. If everyone moves, there are few if no gains in safety; furthermore, some persons -- blacks, for example, -- experience great difficulty in moving to a safer area. Either the costs of moving into such an area are high (in terms of community resistance, housing prices, or restrictive real estate practices) or the benefits to be obtained are rather low (if many crime-prone elements of the population follow the pioneer black families into a new neighborhood, thereby increasing the crime rate). It is harder for law-abiding black families to put enough distance between themselves and non-law-abiding blacks than it is for law-abiding whites to separate themselves from criminal whites. Increasing numbers are managing to do it, however, and thus for them, as for most people, intra-metropolitan relocation remains the best available means of reducing the risk of robbery; highly selective relocation may reduce the risk of burglary, but not by as much.

This much is obvious to the average citizen and millions of persons have acted on this knowledge. The problem for the policy analyst is to find less obvious and perhaps less costly means for further reducing the risk of

victimization, especially for those who cannot or will not relocate. The number of such means is discouragingly small.

Hardening the Target

One form of personal risk reduction is to "harden the target" -- that is, to increase, at the point of the crime, the costs of committing the crime by making an object harder to steal, a building harder to enter, or an alarm summoning the police more likely to be triggered.

Since a large proportion of all burglaries are committed by unskilled persons who often act opportunistically rather than by careful plan, devices that prevent entry into a building can often prevent the crime. (There are few, if any, devices that will defeat a determined professional thief).

Some methods of hardening the target may reduce the risk of crime to the occupant of that target but only by displacing the crime onto unhardened targets nearby. For example, if I place deadbolt locks on all my doors, the chances of my less cautious neighbor being victimized may go up. We can find no well-designed studies that test either the security or displacement effects of locks and alarms. Arlington, Virginia, amended its County Code in December, 1971, to require deadbolt locks on all apartment doors and special latches on all first-floor windows. By the end of 1973, all but 2 percent of the apartments were reported to be in compliance with the law. Apartment burglaries dropped sharply in February, 1972, and remained well below 1971 levels throughout the year. Data from 1973 are not completely available, but apartment burglaries were starting to rise again in early 1973. Burglaries of houses, not covered by the law, rose during 1972. (White, et al., pp. 24-25, 54) Some of this house burglary may reflect displacement from apartments.

Burglary alarms have not been comprehensively evaluated. One California

study found that one half of the burglaries of alarmed sites were not detected because the burglars defeated the alarms; furthermore, the false alarm rate was very high. (White, et.al., pp. 33) It is possible, however, that even with many false and defeated alarms, the proportion of burglars caught entering alarmed spaces is higher than the proportion caught entering unalarmed ones. The best study we can find of this is one carried out in Cedar Rapids, Iowa, beginning in 1969. Silent alarms connected to the police station were placed in over one hundred locations; and these sites were matched to a control group of an equal number of buildings without alarms. During 1970-1971, the burglary rate in the places with alarms was as high as the rate in places without them -- about one fourth the locations in each group were burgled. But in the sites with alarms, arrests of burglars on the scene were four times as frequent as on-scene arrests at sites without alarms. (White, et.al., pp. 71-72)

Street lighting is popularly supposed to be an effective deterrent to street robberies. Most of the studies on which these suppositions rest are of little value as they rely on observing only for short periods changes in crime rates on lighted streets, without taking into account the possible displacement of crime or whether the effects are long lasting and without specifying control areas to measure the effects of other, non-lighting, changes. One of the few studies that attempts to surmount these limitations was carried out in Kansas City, Missouri, in 1971-1972. Bright, new lights were placed on about 500 city blocks. Analysts from the University of Michigan compared changes in reported crime rates in 129 of these blocks before and after the relighting and also compared the after-lighting results on these blocks with reported crime in a sample of similar blocks that were not relit. Nighttime, on-the-street crimes of violence -- assault and battery -- decreased

by 48 percent after the blocks were relit. On the unrelit control blocks, these crimes decreased by only 7 percent. As a further check, the authors looked at crimes being committed during the day or indoors in these relit blocks. Neither daytime crimes nor crimes occurring indoors showed any decrease during the study. They could not measure directly the amount of street crime displaced to nearby, unlit streets; they estimated that about one fourth of the crimes not occurring at night on relit streets had been displaced to unlit streets. In short, the analysts concluded that a genuine reduction in street robberies and assaults at night occurred in the relit blocks; there was no statistically significant reduction in burglaries or larcenies, however. (Wright, et.al.)

A good deal of attention has been given to the possibility of personal risk reduction by means of technology -- equipping citizens with alarms, whistles, mace, guns, and even bullet-proof vests in order to permit them to resist robbery, summon help, or frighten off the robber. There is no information of which we are aware that indicates whether any of these measures work but there is a great deal of data to show that the vast majority of citizens do not employ them. In the victimization survey, respondents were asked whether they took any self-protective measures at the time they were robbed or assaulted. About half said they did, but in the majority of cases the measures were to hit the attacker with the bare hand or to run away. Scarcely anyone used a weapon and, interestingly enough, only a small minority yelled for help. The likelihood of fighting or running was greatest, not surprisingly, for the younger victims; older victims were more likely merely to yell, if indeed they did anything. It is possible that equipping those who cannot fight or run with more effective ways of yelling -- an alarm, for example -- might help them avoid losses, but it seems unlikely that any

government program to do this would attract the interest of many persons. Various alarms are on the market now, yet few use them. Citizens who refuse to use seat belts in their cars are not likely to tote around robbery alarms, especially since no one knows whether the alarms will make matters better or worse.

Though it is unrealistic to expect citizens to protect their persons in ways that are either costly or risk-enhancing, it may be more realistic to devise ways to protect the spaces and premises in which citizens move. In 1971, two major studies were published addressed to the problem of achieving "defensible space", one by Oscar Newman, and the other by William Fairley and Michael Liechenstein. Newman was concerned with how best to design housing projects so that their features will discourage criminals from using, and encouraging residents to use, public spaces in and around buildings. (Newman) His data, and data from the New York City Housing Authority, suggest that robberies and burglaries in housing projects increase in rate as the height of the building increases from about five to about thirteen stories; the crime rate is unaffected by height below five stories or above thirteen. Furthermore, robberies and other crimes against person are most likely to occur in low-visibility public spaces: elevators, stairwells, walled-in lobbies, and corridors with frequent turns. Finally, projects with many dwelling units have higher crime rates than those with few units, independent of building height.

Fairley and Liechenstein, on the other hand, take the existing design of a building as given and estimate the effectiveness of various security systems -- locks, alarms, guards, surveillance equipment, and so forth. Like Newman, they carried out no experiment involving making and evaluating the changes; furthermore, the data employed are frequently rough estimates. Their

conclusions are, not surprisingly, that security systems do make a difference in victimization, both for robbery and for burglary occurring in buildings, but that the effectiveness of these systems is closely related to their cost. The cheapest system -- locking the lobby door and having an intercom with which visitors announce themselves -- is the least effective; the most expensive system -- locks plus a full-time guard in the lobby, surveillance by closed-circuit television, and individual alarm systems in each apartment -- was the most effective. (Fairley & Lichtenstein)

Newman's proposal is helpful to those planning new buildings but of little value to those occupying existing ones. And the cost of adopting the most effective security system for an existing building would necessitate an increase of 37.7 percent in the monthly rent per tenant. Affluent tenants can and do pay these costs; poor tenants cannot.

Whether citizens should be expected to absorb the full cost of design and security features intended to reduce crime or whether some or all of these costs are public goods properly eligible for public financing is an interesting and complex question. Clearly, low-rise, low-density public housing projects with ample security systems are much more expensive than conventional projects; just as clearly, public expenditures on such projects are now set sufficiently low to discourage extensive use of "defensible space" concepts.

PUBLIC DEFENSE

The crime-reduction measures thus far considered have one thing in common: they by and large involve self-protection measures that require the active participation of the would-be victims of crime. Some of them, such as residential relocation, offer to any given individual the opportunity to reduce substantially his risk of victimization. No direct public outlays would be required for this "policy" but neither can such a policy be useful for more than a fraction of potential victims. Furthermore, the gains to the individual would be greater for robbery than for burglary. Other self-protection measures offer (as far as we can tell from very sketchy data) either little gain to the individual (as with personal self-protection measures) or require joint action by many individuals and substantial shared or public expenses (as with building security projects).

We now turn to crime-reduction measures that involve policies aimed at actual and prospective criminals. To oversimplify, such policies may seek to change the preferences of actual or potential offenders, to change the behavior of potential offenders by altering the perceived costs and benefits of acting on the basis of unchanged preferences, or to prevent the predatory behavior of offenders by physically restraining them from acting on the basis of whatever preferences and whatever benefits.

When we change the preferences of potential criminals by increasing their attachment to law-abiding norms or by decreasing their taste for risk, we are engaged in reducing the recruitment of criminals (often called, too broadly, "crime prevention"); when we succeed in doing the same thing with persons who have already engaged in criminal acts, we say we have rehabilitated the offender. When we change the behavior of offenders by increasing the

net costs of crime above the net benefits without altering the offender's attachment to law-abiding norms or his preference for risk, we can say we have deterred criminals. When we physically restrain offenders, usually by confining them in jails, we say we have incapacitated them.

Prevention and rehabilitation

In recent years, grave doubts have been raised about the efficacy of known methods for either reducing the recruitment of criminals or rehabilitating existing ones. As for the latter strategy, the evidence to date seems fairly clear: no methods that have been carefully evaluated thus far offer any reason to believe that convicted offenders can in large numbers be rehabilitated such that their future propensity to break the law is materially reduced as a result of a deliberate third-party intervention. (Martinson; Wilson). This is not to say that once a criminal, always a criminal: a large number of offenders do not become repeaters whatever society may or may not do. Nor does it mean that society can do nothing of value to an offender when it has him in its clutches: illiterates may be taught to read, health problems may be remedied, job training may be provided, and all of these may be helpful to the inmate and perhaps even useful to society though such programs, so far as present evidence suggests, do not alter significantly the chances of the offender being a repeater.

The evaluation of rehabilitation programs has been the subject of a number of major studies and their findings -- almost without exception, negative -- need not be reviewed here. Because important segments of public opinion as well as many judges and correctional officers believe that rehabilitation is possible, it is important to make it crystal clear that there is at present no factual or scientific support for that belief. And it is

not for want of trying: well over two hundred serious efforts have been made to discover whether rehabilitation works, many written by persons who wanted it to work, but these efforts so far have come to little.

No such categorical judgment can be made about efforts to reduce the recruitment of first-time offenders. The fact that most young persons do not commit a serious crime while growing up suggests that something operates in our society, and in all societies, to induce conformity to law-abiding norms or the avoidance of the risk and stigma of arrest. Familial and peer group processes make most of us conform to most laws most of the time and to some laws all of the time. But these are processes that go on under private, not public, auspices and in ways that no government program has managed to duplicate. There has always been a substantial relationship between growing up in a disorganized, loveless family and getting in trouble with the law and there is no reason to assume that relationship -- which we suspect is causal -- will change. (Monahan; Bronfenbrenner; Wilson)

But the difficulty with any planned effort to reduce the recruitment of new offenders is the fact that we do not know how to organize disorganized families or bring affection into loveless ones. And even if we knew how to do these things, we would have to direct such programs either to a very large number of persons -- perhaps all persons -- or we would have to devise a means of predicting who is likely to become a criminal and direct them at these few. The first approach is likely to be ruinously expensive -- or to put it more precisely, quite inefficient, for many resources would of necessity be spent on persons who, if left to their own devices, would become quite law-abiding anyway. The second approach may well lead us to stigmatize "problem" families by predicting for their offspring a criminal career: not a serious problem, perhaps, if our prediction methods

were very reliable, but quite a problem if we score many "false positives" (i.e., if we wrongly predict that someone will become criminal). Our wrong predictions may become self-fulfilling prophecies. Furthermore, by the time we have enough information about a young person or his family to be reasonably sure that, without our intervention, he is headed for a life of crime, he may have aged beyond the point where any preventive program can change him.

These issues should not be interpreted as conclusive arguments against any effort to prevent the recruitment of a new criminal but only to suggest how unlikely it is that we shall have many successes or even that we shall know whether or not we have succeeded. We continue to try, nonetheless, through the school system, counselling programs, and various forms of individual and group therapy, but facts as to the success of these programs in diverting from crime persons otherwise disposed toward it are thus far fragmentary and unconvincing.

Nothing in this paper should be read as an argument against improving the incomes and opportunities of citizens. The ways by which some such improvements might be affected for urban residents are the subject of several other papers now being written at the Urban Institute.* It would be a mistake, however, to suppose that reducing poverty, improving housing, or equalizing educational opportunities will, of themselves and in the short run, contribute substantially to a reduction in predatory crime. Indeed, as stated at the outset of this paper, the experience of the last decade is consistent with (but does not prove) the opposite view. The case for improving

* This paper and five others on housing, poverty, transportation, education, and fiscal problems of cities are to be published by The Urban Institute as a single edited volume in 1976.

the quality of life ought to be made on grounds other than the short-term impact of such improvements on crime rates and, further, to the extent crime rates rise during periods of prosperity, increased efforts should be made to control crime in order that rising crime is not used to discredit other social policies and is not allowed to shift the costs of social change onto to those (the poor, the elderly) least able to afford them.

It is, indeed, precisely the uncertain relationship between social progress and crime, as well as the difficulties attendant on efforts to produce social progress, that leads us in this paper to emphasize those manageable institutional changes that may reduce, or slow the rate of increase in, crime.

Disarming the criminal

One way often suggested to reduce crime is to disarm criminals. Perhaps taking weapons away from robbers would reduce the number of robberies. Though there may be good arguments for gun control with respect to other crimes, it is not clear that such controls would affect the robbery rate and there is some chance that if effective these controls would actually increase the number of persons injured in robberies.

The most persuasive argument for denying citizens access to hand guns is that in a large number of assaults and murders the difference between serious or fatal injuries on the one hand and none or a minor injury on the other results from the differential availability of a gun. Fights among friends or relatives can become murders if, in the heat of the moment, one party or both can put his or her hands on a gun even though no one planned to use a weapon because no one had planned to fight. The larger the caliber of the gun the greater the chances of a fatal injury. (Zimring) Whether legislation could be designed and implemented that would remove any

significant number of such guns from the premises of those most likely to engage in deadly quarrels is another matter, given the very large number of handguns in private ownership, the unwillingness of people to surrender them voluntarily, and the restrictions on police powers to search for and seize contraband.

All these difficulties are much greater in the case of robbery, for here we are attempting to reduce, not the casual availability of a weapon, but the extent to which criminals planning a robbery can obtain and use a weapon. Preventing a determined robber from finding a weapon seems much harder than preventing an irascible citizen from coming upon a weapon at the moment a quarrel breaks out. On the other hand, we have not sufficiently explored the deterrent possibilities available in making sentences for persons arrested for assault or robbery depend on whether a weapon was used. If assaulters and robbers knew that they would face a much higher penalty if caught with a weapon, it is not unlikely they might make less frequent use of weapons. (Zimring) Unfortunately, there have been few if any studies of this possibility and there is good reason to suspect that the courts do not act on this principle. In the case of assault, if friends or acquaintances are involved, the case is typically dropped without prosecution if the "victim" so wishes, whether or not a weapon was employed. In the case of street crimes, the police report great difficulty in finding judges who will impose penalties for illegal possession of weapons. Massachusetts now has on the books a law mandating a one year jail sentence for anyone caught with an unregistered gun; experience with the law is too brief to permit an assessment of its effect.

But there is an even greater problem. Every study we can find shows that there is a greater chance of injury resulting from unarmed than from

armed robberies. (Curtis, p.115; Reppetto; Conklin; Normandeau; Eeeny and Weir) The reason is simple: displaying a weapon makes credible to the victim the verbal threat of the offender. An unarmed robber must often use force instead of merely threatening it, and so the victim is struck. On the other hand, the greater cost of obtaining a gun may induce some would-be robbers (especially those of slight stature!) to foresake robbery for crimes not requiring force. Whether the reduction in total robberies would offset the increase in injuries from the greater proportion of unarmed robberies is an interesting problems in cost-benefit analysis; we know of no data with which to address it.

Deterrence

If prevention, rehabilitation, and disarmament are of uncertain value, and if we are not willing to lock ourselves indoors and thereby abandon the streets to the criminal, it becomes important to look carefully at the deterrent effect of the criminal justice system. The renewed interest of late in deterrence reflects in part the belief, still under investigation, that we can more easily develop effective techniques in these areas than in those that require changing human attitudes, in part the recognition that programs directed at known offenders may prove less costly than ones aimed at all potential offenders, and in part the desire to avoid some of the unjust implications of the prevention and rehabilitation strategies (e.g., allowing prison terms to be affected by an inmate's prospects for rehabilitation rather than the nature of his offense or wrongly stigmatizing potential offenders).

Most deterrence theories are based on the assumption that would-be offenders are rational and take into account, however, imprecisely, the

costs and benefits of alternative courses of action. This assumption may be unwarranted for so-called "crimes of passion" (though there are many who stoutly deny even this) but there is little evidence to suggest that it is unwarranted for crimes committed for material profit. Such theories also recognize that offenders may differ greatly from the law abiding population in their taste for risk and in how they value both the costs and benefits of crime, but that like everyone else they respond to incentives. That is, if the costs of crime are increased or the benefits drop, there will be some criminals for whom the benefits no longer outweigh the costs and there will be fewer crimes. These theories, however, tell us only that there should be some effect and nothing about the magnitude of the response that will be observed. The latter must be determined by empirical estimation.

Most empirical studies of deterrence do not test all aspects of the rational actor model. The earliest and still the most numerous examples of these studies consider only the probability of imprisonment (the "certainty" of punishment), sometimes controlling for various population characteristics (e.g., race or region). The measure of certainty is the number of known offenses (say, robbery) divided into the number of persons sent to prison for that offense in a given year. The larger the ratio of sentences to offenses, the more "certain" the punishment. The measure of severity is the average time served in state prisons by persons convicted of a given offense. In general, these studies -- summarized by Tittle and Logan and also by Tullock -- support the proposition that the more certain the penalty for a given offense, the lower the rate at which that offense is committed. Results with respect to the severity of punishment are somewhat less consistent, but a number of researchers do report a negative relationship between crime rates and the average length of a prison term. Where an attempt is made to determine the relative importance of the two

variables the usual conclusion is that the frequency of punishment rather than its duration has the greater effect.

Unfortunately, attention to the "certainty" variable, primarily because of data constraints, neglects the fact that the probability of arrest for a given offense may or may not vary independently of the probability of being sentenced. Ideally, one would like to know the relative deterrent effect of each variable: what deters may be the chance of being arrested rather than the chance of being imprisoned. This is no small matter, for only a small proportion of those arrested for a felony are imprisoned for one. We want to know whether it is better to invest more heavily in police resources or court resources and prison space.

More sophisticated studies of deterrence generally use the same measures of certainty and severity but have the advantage of taking into account the benefits of legitimate alternatives to crime as well as the costs of crime. Ehrlich, for example, considers the would be offender to be choosing between licit and illicit activities each of which generates payoffs proportional to time spent on them. Participation in illegitimate activities (i.e., the crime rate in a given state) is thus a positive function of the extent to which net returns from crime exceed the net returns from legitimate activity. The value of illicit and licit opportunities are measured by median family income and the proportion of families with incomes less than half the median, respectively, while the costs of crime are measured by the usual "certainty" and "severity" measures described above. Other studies, which do not include criminal justice variables but do attempt to estimate the effects of the availability of legitimate opportunities on crime, measure opportunities by

using mean family income of the second lowest quartile of the income distribution (Fleisher), the unemployment rate (Fleisher), or the labor force participation rate (Phillips, Votey, and Maxwell).

These studies have more or less consistent findings. Fleisher finds that as unemployment increases over time and across jurisdictions, juvenile arrest rates go up (and presumably the actual rate of juvenile delinquency goes up as well). He also finds a consistent negative relationship between low levels of income and arrest rates in several cross sectional samples of various types of communities. Ehrlich finds that the rate of burglary, larceny, robbery, and auto theft go up as median income rises and as the proportion of families earning less than half the median income goes up. He also finds that, independent of changes in the economic variables, the rate of crime goes down with an increase in the probability and severity of imprisonment. The work of Phillips, Votey, and Maxwell suggests that crime rates for 18 to 19 year old males for burglary, robbery, larceny, and auto theft were highly sensitive over several years to labor market conditions. They argue, further, that labor force participation is a more important explanatory variable than unemployment with respect to changes in property crime for this age group. Unemployment rates measure only short-run experiences with job-hunting and, since a large fraction of young people are outside the labor force at any given time, fluctuations in unemployment affect a relatively small fraction of all youth.

In sum, there is a good deal of evidence, employing a variety of techniques, that is consistent with (but does not prove) the theory that property crime rates will decline as the availability and value of legitimate opportunities increase, the benefits of crime drop, and the costs of punishment are

increased. Indeed, an even more specific statement can be made: there are not, to our knowledge, any studies that suggest that the rate of reported property crime is insensitive to the probability of imprisonment.

But virtually all of these studies suffer from problems of measurement and data accuracy. Most use FBI Uniform Crime Report statistics of crime for entire states, reports which almost certainly vary enormously in quality. Indeed, most authors note the discouragingly poor quality of these data and numerous discussions by others appear in the academic literature (Doleschan and Wilkins, Sellin and Wolfgang, Hindelang). Differences in crime rates that are observed across jurisdictions may represent, in addition to differences in the behavior of criminals, differences in the proportion of victims who decide to report crimes to the police and/or differences in the methods and skill with which local police departments record and report crimes to the FBI.

We can deal with at least one aspect of the data problem by estimating the effect, if any, of the criminal justice system on crime rates derived from victimization surveys rather than official FBI police reports (with the data aggregated by cities rather than by states, and employing a different measure of deterrence). Though our method is also open to criticism, it has the virtue of being empirically independent of the estimates now available and thus, should it provide findings consistent with those estimates, would tend to increase our confidence in them.

We shall attempt to see whether differences in the rate at which persons (not business establishments) are victimized by robbers in 26 large American cities are related to the level of police activity. We shall use as our

dependent variable the rate (per thousand persons over the age of 12) at which individuals were victimized by "serious robberies" (those in which more than \$10 was taken). The measure of police activity is the total arrest rate for robbery: that is, the total arrests for robbery that occurred in a city in a given year divided by the total number of robberies reported in the victimization survey for that city during a roughly comparable time period.

Our focus on personal robbery is dictated partly by a priori value judgments about the type of crime citizens find most fearsome and partly by data constraints. Robberies occur with sufficient frequency to allow detailed analysis and, by definition, they involve personal contact and the use of force. Also, the typical robbery is committed in open public spaces by person(s) unknown to the victim(s) -- in our sample of twenty-six cities approximately 90 percent involved strangers and about 65 percent occurred in the street. (Commercial robberies have been excluded because of unreliability suggested by sampling error calculations.) We use the serious robbery rate rather than the total robbery rate because, as noted earlier, persons frequently victimized may not recall and report "minor" robberies, even to Census interviewers, as reliably as persons less frequently victimized. Relying on the total robbery rate, we believe, may lead to a bias in our equations resulting from understating the rate of victimization among poor, black, or otherwise frequently victimized populations.

We have already seen that the robbery rate varies considerably among the cities; so also does the probability of arrest. For the latter the mean is 0.143, the range from a low of 0.057 (in Portland and Houston) to a high of 0.318 (in Washington, D.C.). Stated another way, 14 percent of the robberies

on the average result in an arrest, but the Washington police arrest robbers at a rate nearly six times greater than the police in Portland and Houston. We have chosen the probability of arrest to represent the degree of risk associated with robbery, not because we think the police are more important than other elements of the criminal justice system, but rather because measures of these other elements (i.e., courts and prisons) are virtually impossible to obtain at the city level.

Obviously, more than the criminal justice system will affect the crime rate. For our model, in addition to the arrest rate for robbery, we select one variable (rate of participation in the labor force in 1970 for men ages 22 to 34 living in central city low income areas, U.S. Census, 1970) as a measure of the extent to which the population is engaged in legitimate alternatives to crime by working or actively seeking work, one variable (percent of the population that is nonwhite, U.S. Census, LEAA Victimization Surveys) that summarizes a combination of social factors relating to the level of need and the degree of attachment to conventional norms, and one variable (1970 population density per square mile, 1971 Statistical Abstract, pp. 829-889) that estimates the ease or frequency with which a robber comes into contact with a potential victim as well as the degree of anonymity one can have "on the street." The hypothesis is that the robbery rate will increase as the risk of apprehension and participation in the labor force decline and as population density and the proportion nonwhite increase. When a large number of blacks perceive that they have few legitimate opportunities for earning money, observe that the chances of being caught for any given robbery are low, and live in a city that affords by its

density many opportunities for robbing under conditions that supply some anonymity, the victimization rate for robbery will be higher than when any or all of these conditions are reversed.

The full equation (estimated by ordinary least squares) is given below. We shall interpret it and then deal with the qualifications and problems it presents:

Table 3

Regression on serious robbery rate of probability of arrest
and three socioeconomic variables for 26 cities

<u>Variable</u>	<u>Coefficient</u>	<u>t-statistic</u>	<u>Elasticity</u>
Arrest probability	-26.06301	-4.1161	-0.46618
Percent nonwhite	0.13319	5.0152	0.50208
Labor force participation	-0.06865	-0.4677	-0.76390
Density	0.00033	4.2171	0.39300

Constant = 10.7877; corrected $R^2 = .74$; $F = 19.149$

The signs of each of the independent variables are as predicted and the total explanatory power of the equation is quite high ($R^2 = .74$). Three of the four independent variables are highly significant. The elasticities of the variables suggest that a 10 percent increase in the proportion of the population that is nonwhite will, other things being equal, produce a 5 percent increase in the rate of serious robberies; a 10 percent increase in the population density will, other things being equal, produce a 4 percent increase in the rate of serious robberies; and, most interesting, a 10

percent increase in the robbery arrest rate will produce nearly a 5 percent decrease in the rate of serious robberies.

We are not certain whether the labor force participation rate in fact has no significant influence on the robbery rate or whether its effect is masked by other variables. When density is omitted from the equation, labor force participation is significantly and negatively related to the serious robbery rate ($B = .0427$, $t = 2.689$, elasticity = -4.75). Population density and labor force participation are highly correlated, however (the densest cities have, on the whole, the lowest rates of participation in the labor force), and thus when density is entered, labor force participation becomes an insignificant variable.

Nor are we certain how to interpret the density variable. There are three obvious possibilities. One, our original hypothesis, might be called the "opportunity" theory: the denser the population, the more frequently and easily a robber can find a victim. Robbers are not highly mobile -- much less mobile, for example, than burglars. (Repetto.) Other things being equal, it is easier to find victims in downtown Manhattan than in downtown Portland. The second is the "subculture" theory: dense cities should, as predicted by Wolfgang and Ferracuti, make it easier for like-minded individuals to find and associate with each other under conditions of weak communal control and so, by their interaction, intensify such proclivities as they may have for criminal activity. The third is the "regional" theory: certain regions by their history, traditions, and patterns of settlement have long records of high urban crime rates -- the older, industrial cities of the Northeast have always had more crime than

the cities of the Far West and especially the Northwest, while blacks living in Southern cities tend to have lower crime rates than blacks living in Northern ones. We do not choose among these interpretations of the density variable; indeed, all may be true in varying degrees.

The apparent effect of police arrest rates on robbery is a controversial finding. At the methodological level, there is a question as to how to interpret the direction of causality. A high arrest rate may cause by its deterrent effect a low robbery rate or, conversely, a high robbery rate may produce a low arrest rate. The latter could be the case if, for example, a larger number of infrequent ("amateur") robbers were active: their aggregate level of crime would increase the robbery rate, but the infrequency with which any given robber robs would make it more difficult for the police to catch him. In addition, when the ratio of arrests to robberies is used to measure the arrest rate, robberies appear in the numerator of the dependent variable and the denominator of the independent variable. If there are errors of measurement in the number of robberies spurious negative correlation between the robbery rate and the arrest rate may result.*

We can cope with these problems by deriving a statistical estimate of police activity independent of the number of robberies. We asked three senior staff members of The Police Foundation, a nonprofit organization that works with and thus is familiar with local departments, to rate independently each of the 26 cities in our sample as having either professional, aggressive

*

This and other problems of measurement in the probability of arrest variable are discussed in the technical appendix.

departments or relatively nonprofessional, lax departments. There was a correlation between these expert ratings and the arrest rate of each department. Of the nine departments rated "professional," eight were above the mean in robbery arrest rates; of the fourteen cities rated "nonprofessional," ten were below the mean in arrests. (Three were not rated for lack of knowledge.)*

If we use the expert ratings as a dummy variable in our estimation equations in lieu of arrest rates, we obtain the results shown in Table 4 below. The R^2 is .70 and the three variables found significant in the previous equation remain significant with the same signs though somewhat changed values. The coefficient of the "police efficiency" dummy variable is 2.536, suggesting that cities with "professional" departments have 2.5 fewer serious robberies per thousand population than those without them. (The mean number of serious robberies in the sample is 8 per 1,000 population.)

On a substantive level, this finding may seem to contradict the various studies, such as the Kansas City patrol experiment, suggesting that police make no difference in crime rates. (These studies are reviewed in Wilson, 1975, Chapter 5.) In fact there is no contradiction. The Kansas City experiment tested the efficacy of random preventive patrol in marked police cars and found that this strategy made little difference in crime rates. There has been no published experiment, comparable in quality and evaluation, of other police strategies aimed at crime. Non-experimental police data suggest that certain strategies (e.g., "decoy" units) produce much higher arrest rates than either

* Professional departments are Cincinnati, Dallas, Los Angeles, New York, Oakland, Portland (Oregon), St. Louis, San Diego, and Washington, D.C. Buffalo, Minneapolis, and New Orleans were not rated.

Table 4

Regression on serious robbery rate of estimate of police efficiency and three socioeconomic variables for 23 cities

<u>Variable</u>	<u>Coefficient</u>	<u>t-statistic</u>	<u>Elasticity</u>
Police efficiency (0,1)	-2.53665	-2.8757	
% nonwhite	0.07505	2.5273	0.28657
Labor force participation	-0.17960	-0.9849	-1.9715
Density	0.00033	3.3044	0.39610

Constant = 19.73084; corrected $R^2 = .70$; $F = 13.529$

patrol or follow-up investigation (Abt Associates) but there is as yet no information on the relationship between those strategies and crime rates.

Though no set of controlled experiments either denies or confirms the crime reduction potential of the police, our finding that police behavior makes a difference is consistent with other recent studies employing the same techniques with police reports of crime (as opposed to victimization surveys). Tittle and Rowe analyzed crime and arrest rates for cities and counties in Florida using partial correlation techniques and found that, above a certain threshold level of arrests, high arrest probabilities were associated with low rates of serious reported crimes. (Tittle and Rowe) Sjoquist, using ordinary least squares estimation techniques, found that high arrest probabilities are significantly associated with decreases in the rates of robberies, burglaries, and larcenies over \$50. (Sjoquist) Both these studies used the customary controls for socioeconomic variables.

Another methodological issue concerns the specification of the model. It is possible that selecting different variables would eliminate the effect of the police variable or increase the significance of (changeable) socioeconomic variables. We have experimented with other variables, and find none significant. If the proportion of persons with incomes below half the median is substituted for the proportion nonwhite, it is significant, but entering both variables simultaneously eliminates the income effect. In short, race dominates income for reasons we do not fully understand. We do know that this is consistent with the findings of other studies. In their study of a cohort of ten thousand Philadelphia boys, Wolfgang, Figlio, and Sellin found that the probability of committing an offense was higher for

nonwhites than for whites at all socioeconomic levels; indeed, the probability of committing an offense was higher for high-status nonwhites than for low-status whites. (Wolfgang, et al., 1972, p. 301.) The conditions under which nonwhite children grow up are so profoundly different than those under which white ones are reared that they cannot be captured merely by measuring income differences.

Nor are measures of income inequality (Gini ratios) significantly related to robbery rates when other factors are controlled, though in a simple correlation, the Gini ratio is negatively associated with robbery (that is, the greater the degree of income inequality, the lower the robbery rate). This may reflect the disproportionately low robbery rates in many Southern cities where income inequalities are high.

City size is related to robbery rates -- the bigger cities have higher rates -- but that relationship disappears when density is controlled. Density is a much more powerful explanatory factor, at least for this sample of cities.

The age structure of the population has no affect on the robbery rate, probably because there is relatively little variation in age structure among these cities (except for Miami, with many older persons, and Boston, with a large youthful, probably student, population). Furthermore, cities with low crime rates are more likely to retain within their boundaries families with children than cities with high crime rates, and this fact would confound the predicted effect of youth on crime.

Beyond these methodological issues there is a more important substantive issue. It is possible that the results we observe in these equations are not

caused by what the police -- or the police alone -- do, but by what other parts of the criminal justice system do with persons the police have arrested. Since we do not have measures on courts and corrections, some of the deterrent effect we are attributing to police efficiency may, for example, represent court efficiency. But even more important, we do not know whether high arrest or imprisonment rates are deterring would-be criminals or whether these prohibitions are deterring no one but are simply reducing the supply of active offenders by turning a large number over to the courts that in turn send a greater number of them to prison.

What we have called the "police" or "arrest" variable in our equations would be better termed the "criminal justice variable" -- an institutional intervention in the city, initiated but not limited to the police, that by either deterrence or incapacitation or both affects the rate at which serious robberies are committed.

In sum, our initial hypothesis is partially confirmed: low density cities with high arrests and low proportions of nonwhites will have fewer serious robberies than cities with any or all of the opposite characteristics -- though we acknowledge our uncertainty as to the exact causal significance of "density" and "arrest." Our measure of the availability of legitimate economic alternatives to crime did not prove to be significant at the city level, though studies using national, state-wide, and sub-city data have indicated its importance. These other studies give support to the value for crime reduction of increasing the employment of young males; our study adds support to the view that increased levels of criminal justice activity can also reduce serious robberies. In the next section we shall take a closer look at another strategy -- incapacitation.

Incapacitation

Two separate lines of inquiry -- one using police reports of crime aggregated by states and the other using victim reports of crime aggregated by cities--suggest that differing levels of activity of the criminal justice system will, even holding economic "need" and criminal opportunities constant, produce different rates of crime. Just what this "criminal justice activity" may be and how it affects crime rates, however, is not clear. Deterrence theory rests on the assumption that would-be offenders observe and act on differences in the risk of apprehensions or imprisonment. Available data are consistent with the hypothesis that they do act on these perceived differences, but unless a controlled experiment is conducted it is possible that differences we attribute to deterrence effects are in fact due to incapacitation. A deterrent effect may be operating, but whether the deterrence is the result of arrest rates, conviction rates, imprisonment rates, length of prison term, or some combination of all of these is uncertain and therefore deterrence research to date offers one little guidance about the point in the system in which one ought to invest the greatest resources. (It is also possible that the association between the criminal justice system and crime that we observe represents neither deterrence nor incapacitation but is the result of variables we have not considered or to some systematic measurement error. We think this unlikely, but it cannot be ruled out.)

Some but not all of these problems are avoided by examining the effect on crime of incapacitating (by jail or prison) the convicted offender.

The effects of incapacitation require one to make no assumptions about the perceptions of offenders. A person confined in an institution cannot victimize persons outside that institution. A large proportion of the persons arrested on felony charges are not so confined.

The percentage of those convicted on felony charges who are sent to some kind of institution (jail, work camp, prison) seems to vary considerably among jurisdictions and over time. In California in 1970, of those convicted of robbery, 32 percent went to prison (meaning they received a sentence of one year or more in confinement), 8 percent went to jail (and thus were confined for periods less than one year), 29 percent were given a sentence combining jail and probation. The remainder were fined, placed on probation, sent to the Youth Authority as minors (what disposition the YA made is unknown), or civilly committed because of drug abuse. Within the state, however, there was considerable variation in sentencing. Only 24 percent of those convicted of robbery in Los Angeles were sentenced to prison (what proportion went to jail is unknown). Only 37 percent of those convicted of robbery with a prior prison record were sentenced to prison. (Greenwood, et al., pp. 109-110.) This last figure means that 63 percent of those convicted of robbery, who had a prior prison record, were either not confined or confined for a period of less than a year.

In Washington, D.C., by contrast, the court in 1971 found 420 persons guilty of robbery; 84 percent were imprisoned, almost all for periods in excess of one year. (Federal Offenders in U.S. District Courts, 1971, p. 77.)

Further complicating this matter is the fact that the time actually served in prison is typically much less than the time to which persons are sentenced. For example, persons convicted of robbery who were released from

federal prisons in 1970 had served, on the average, only 41 percent of the sentence imposed by the judge. Though the typical sentences imposed by federal judges have been increasing in severity for the last decade or so, the percent of the sentence actually served has been declining just as rapidly, so that over this period the average time served in prison has remained about the same. (Sourcebook of Criminal Statistics, 1973, pp. 416, 418.) Data from state court systems suggests that the probability of going to prison has been declining there also while average time served has been roughly constant. Overall, the prison population of the United States dropped during the 1960's despite a sharp upsurge in the amount of crime being committed.

During the decade of the 1960's, there was a decrease, nationally, in both the proportion of all reported crimes that resulted in arrests and in the proportion of all arrests that resulted in imprisonment. In 1960, there were 24 arrests for every 100 "Index" crimes; in 1970, there were only 16 arrests for every 100 Index crimes. In 1960, 24 persons went to state prisons for every 100 arrests for Index crimes; in 1970, only 13 persons went to prison for every 100 Index arrests. This means that the combined probability of imprisonment for every 100 Index crimes dropped from 6 per hundred to 2 per hundred.

Some persons arrested for an Index crime might be sent to a local jail rather than to a state priosh. If the proportion sent to jail rather than prison rose substantially during the 1960's, the rates in the preceding paragraph might be misleading. Jail populations did increase in the 1960's, but by less (9,510) than the prison population decrease (16,230). Furthermore, only 21 percent of the jail population at any given moment is serving a

sentence for something more serious than drunkenness, traffic offenses, or nonsupport. Adding this 21 percent to the figures on imprisonment given earlier does not materially change the results: for every 100 Index arrests, 35 persons went to jail or prison in 1960 but only 19 in 1970, a 47 percent decline.

Clearly, a much larger proportion of convicted persons could be sent to prison, if facilities are available, than is now the case. There are, of course, many forms of confinement short of prison -- local jails, work camps, and so forth. Whatever the form or amenity of the incapacitation, the key problem is to estimate the crime reduction potential of sentencing a larger proportion of convicted persons to some institution (instead of granting them probation or suspended sentences or refining them) and then to estimate the costs per crime prevented by that strategy.

To carry out this analysis, one must have data on the following variables:

The size of the criminal population.

The number of crimes committed by any given criminal per year (more accurately, we want to know the frequency distribution of all crimes of a given type over the criminal population).

The probability that a given criminal is arrested.

The probability that a given arrested person is convicted.

The probability that a given convicted person is sentenced to prison.

The length of the average sentence.

Thus far, our ability to construct mathematical models of the crime reduction effects of incapacitation is substantially greater than our ability

to obtain reliable estimates of the key variables. Some, such as the probability of arrest, conviction, and sentencing are known approximately and, happily, do not fluctuate much from year to year. The length of the average sentence is in principle discoverable but, maddeningly, almost no jurisdiction in the country actually compiles these data. We skirt the problem somewhat by calculating the marginal crime reduction achieved by additional increments of time in prison. The size of the "criminal" population, or even the population of robbers, is unknown and perhaps unknowable. In our first use of the model, we simply assume that this population, whatever its size, is constant -- i.e., that a new robber does not immediately appear to replace a robber sent to prison.

But the crucial variable is the average number of crimes per criminal per year (defined in the model as lambda): crucial because the results are highly sensitive to this value and because we know of no accurate way to measure it. It clearly will make an enormous difference in the robbery rate whether the imprisoned robber has committed many or few robberies. For example, a city may experience 1,000 robberies either because 1,000 persons commit one robbery each, or because ten persons commit 100 robberies each, or some combination in between. In the former case, locking up for one year one robber would spare the city only one robbery per year; in the latter case, locking up one robber would spare it 100 robberies each year. We cope with the problem of estimating lambda by giving estimates of the crime reduction potential of incapacitation for various assumed values of lambda.

The first effort with which we are familiar to develop a model such as this was that by Reuel and Shlomo Shinnar of The City College of New York. Their effort was criticized by Alfred Blumstein and Jacqueline Cohen of Carnegie-Mellon University in 1975 (private communication). They pointed out some errors in calculations and noted the failure of the Shinnars to provide a rationale for the empirical values they employed. Most important, the Shinnars assumed that lambda was constant for the entire criminal population (surely not the case) and did not support their estimate that it had a value of ten. Another preliminary effort at measuring the results of incapacitation was carried out independently of the Shinnar work by Jeffrey Marsh and Max Singer of the Hudson Institute in 1972, though their paper does not show the mathematical properties of their model.

The version we use is a refinement of the Shinnar model developed by Ann Young of Harvard. A full specification appears in the appendix. The principal results are given in Tables 5 and 6. In Table 5 is shown the percentage reduction in the crime rate that would occur if everyone arrested and convicted of a crime were given sentences ranging in length from 0.2 years (about two and half months) to 5.0 years, under varying assumptions as to the average number of crimes committed per criminal and the probability of being caught and convicted. These percentages reflect the total reduction in crime from what would occur if no convicted offender were confined at all. For example, if the average criminal commits ten crimes per year and has a 10 percent chance of being caught and convicted, then sentencing all such convicted criminals to one year in prison would lower the crime rate by 50 percent below what it would be if no one went to prison.

Table 5

Percent reduction in expected crime rate produced by
prison sentences under varying conditions of
criminal career and probability of conviction

Crimes per offender	Prob. of conviction	Length of total sentence (years)					
		0.2	0.5	1.0	2.0	3.0	5.0
5	.05	4.8%	11.1%	20.0%	33.3%	42.9%	55.6%
	.10	9.1	20.0	33.3	50.0	60.0	71.4
	.20	16.7	33.3	50.0	66.7	75.0	83.3
10	.05	9.1	20.0	33.3	50.0	60.0	71.4
	.10	16.7	33.3	50.0	66.7	75.0	83.3
	.20	28.6	50.0	66.7	80.0	85.7	90.9
20	.05	16.7	33.3	50.0	66.7	75.0	83.3
	.10	28.6	50.0	66.7	80.0	85.7	90.9
	.20	44.4	66.7	80.0	88.9	92.3	95.2
50	.05	33.3	55.6	71.4	83.3	88.2	92.6
	.10	50.0	71.4	83.3	90.9	93.7	96.2
	.20	66.7	83.3	90.9	95.2	96.8	98.0

(Assumes criminal population is of constant size and that all caught and convicted offenders receive same sentence.)

Obviously, some criminals are given prison sentences; what we wish to know, therefore, is what marginal reduction in crime would result from increasing the length of the sentence by varying amounts and applying that sentence to all persons convicted of the crime. The reductions given in Table 6 are for any state of affairs in which the product of λ and the probability of being caught and convicted (qJ) equals one. For example, the values in the table are correct if the average criminal commits ten crimes per year and has a ten percent chance of being caught and convicted; they are equally correct if he commits only five offenses a year but has a 20 percent chance of being caught. The marginal reductions in crime are substantial (25 percent or more) when the incremental sentence is 6 months or more over an initial sentence of 6 months or less or one year or more over an initial sentence of two years or less.

The cost of a policy of mandatory minimum sentences is an important consideration in evaluating that policy. If we are to double the proportion of convicted persons sentenced to prison, we must double our use of prison space; if we fill the prisons with persons serving one year and then wish them all to serve three years, we must triple the prison space. (We use the term "prison" as shorthand for all forms of separating offenders from potential victims -- by jails, work camps, farms, prisons, community institutions that confine persons at night and on weekends but allow them to work during the day, and so forth.) The capital cost per inmate of such facilities will vary enormously, from minimum security camps to maximum security prisons; operating costs will vary less, because all are labor intensive.

Table 6

Incremental reduction in expected crime rate from
increased in initial sentences, assuming
the product of criminal careers and
probability of conviction = 1

Initial sentence (years)	Increased sentence length (years)					
	0.1	0.3	0.5	1.0	2.0	3.0
None	9.1%	23.1%	33.3%	50.0%	66.7%	75.0%
0.1	8.3	21.4	31.3	47.6	64.5	73.2
0.5	6.3	16.7	25.0	40.0	57.1	66.7
1.0	4.8	13.0	20.0	33.3	50.0	60.0
2.0	3.2	9.1	14.3	25.0	40.0	50.0
5.0	1.6	4.8	7.7	14.3	25.0	33.4

(Assumes criminal population is of constant size and that all caught and convicted are given same sentence.)

Figures from the U.S. Bureau of Prisons on capital and operating costs per inmate of their facilities -- which are generally superior in amenity and design to many state facilities -- are shown in Table 7.

We do not attempt a cost-benefit analysis of increased facilities because the hard-to-measure psychic and communal costs of crime are perhaps the most important of all the costs; inevitably their calculations will be made, implicitly if not explicitly, by the political process.

It is worth noting, however, that the United States has not been willing, during the last decade or so, to increase its use of prison despite the enormous increase in crime. There were 212,957 prisoners at the end of 1960 but only 196,429 at the end of 1970, a decline from 118.6 per 100,000 population in 1960 to 96.7 per 10,000 in 1970. (Statistical Abstract, p. 160.) The number of persons entering prison fell from 88,575 in 1960 to 79,351 in 1970. The decline in the use of prisons was especially marked in some states. New York, for example, experienced a decline in its year-end prison population from 17,207 in 1960 to 12,059 in 1970. (*Ibid*, p. 161.)

There are no doubt a number of reasons why the use of prisons has been declining: Judges, believing that prisons ought to rehabilitate and noting (correctly) that they do not, may put offenders back on the street lest they be corrupted by prison. Or judges may erroneously believe that prison cannot reduce the crime rate either by deterrence or incapacitation. We hope that judges who read our findings will reconsider these views. There is one reason for the reluctance to use prison with which we must deal, however, and that is the crowding effect that the rise in crime may produce on court and prosecutorial schedules. If the number of persons appearing in court has

Table 7

FEDERAL PRISON SYSTEM PER CAPITA
OPERATING AND CAPITAL COSTS

<u>Fiscal Year</u>	<u>Per Capita Operating Costs</u>	<u>Per Capita Capital Costs *</u>	<u>Per Capita Total Costs</u>
1969	3220	47	3627
1970	3676	164	3840
1971	4200	135	4335
1972	4790	142	4932
1973	5302	143	5445
1974	6007 est.	137 est.	6144 est.
1975	7118 est.	137 est.	7255 est.

Source: The Budget of the United States Government, Appendix, U. S. Government Printing Office, appropriate years.

* It may be argued that these per capita capital costs understate the "true" cost of providing "adequate" facilities since many of the prisons within the Federal System are quite old and have been fully depreciated for a number of years. Therefore, an alternative estimate of capital costs has been derived using cost figures for the recently constructed Federal correctional facility in Pleasanton, California. This facility was designed to house 250 young adults between the ages of 18 and 25 under conditions of low security; its initial cost was \$6.6 million. Employing National Bureau of Prisons accounting rules, straight line depreciation over an average life of 50 years, yields an estimate of annual per capita capital costs of \$528.

been rising faster than the time and resources available for disposing of them, then judges and prosecutors will either have to work harder and longer or induce accused persons to consume less time and fewer resources. About all that judges and prosecutors can offer the accused to induce him to consume less is the prospect of a lighter sentence. If true, this relationship has the ironic consequence of increasing the incentives to the criminal justice system for keeping people out of prison at the very time when crime rates are rising and the crime-reduction potential of prison is most needed.

One important rejoinder to this line of argument is that, to the extent prisons are "schools of crime" that increase the recidivism rate of those confined in them, increasing the proportion of convicted offenders sent to prison, or lengthening their terms, would produce ex-convicts who upon their release commit crimes at a greater rate than they would had they not been imprisoned at all. This gain in recidivism, attributable to prison, might nullify most or all of the crime reduction achieved by deterrence and incapacitation.

The evidence on the "schools of crime" hypothesis is not all in. Such evidence as we have been able to find does not, however, strongly support it. Obviously prisons differ greatly in their inner life -- some may have a reasonable level of amenity and privacy, others may so brutalize the convict as to embitter him. And prisoners differ as well: some may be so relieved to get out that nothing would induce them to do anything that would expose them to reimprisonment (and in fact, most ex-convicts are not reimprisoned during their first few years out of prison), while others might set about applying the criminal skills they learned while inside.

David Greenberg, in reviewing studies comparing recidivism rates of released prisoners and matched groups of probationers concluded that "there is no compelling evidence that imprisonment substantially increases (or decreases) the likelihood of subsequent criminal involvement." (Greenberg, p. 23.) This was the conclusion as well of studies by Wilkins, Hammond, Babst and Mannering, Shoham, Lamb and Goertzel, and Beregochea. One of the best known studies sent randomly selected youthful offenders in California to community probation programs and to regular juvenile institutions. There was, after two years, no significant difference in the recidivism rate of the two groups -- suggesting both that the community-based probation system was no better at rehabilitating offenders and the juvenile institutions were no worse at incalculating criminal skills and desires.

Another objection to increasing the use of incapacitation is that our courts and correctional systems will be crushed under the increased workload, partly because more persons will be imprisoned and partly because a higher proportion of those charged will ask for time-consuming trials rather than pleading guilty. The policy we suggest does imply that more resources be devoted to courts and corrections, especially the latter. Only estimates of workloads based on alternative sentencing rules will suggest how great these resources must be and since we propose no specific sentencing policy we make no estimates. It is hard for us to imagine, however, that the dollar cost would exceed what the federal government has already spent on criminal justice through the Law Enforcement Assistance Administration with little or nothing to show for it. The objection based on cost is, we suspect, a disguised form of an objection based on principle: just as those who do not like programs for

income redistribution, job creation, or more schooling object to their cost, so also do persons who do not like prisons object to their cost. We prefer that the issue of principle be faced and debated first in order that we be clear about the benefits, if any; then we should decide what we are willing to pay for these benefits. If citizens were asked to vote on programs that would reduce predatory crime by some significant fraction, we suspect they would approve any reasonable expenditure.

The court workload variant of this objection is more tantalizing. At one level, it suggests an objection to the idea of trials and not-guilty pleas -- strange preferences coming from those who on other issues are strongly committed to the realization of constitutional guarantees. If more accused persons plead not guilty, that is their privilege in any event, we should not sacrifice community protection in order to lighten court workloads. Furthermore, if the chances of imprisonment are increased, there ought to be more trials in order to insure that the more certain prospect of punishment does not result in innocent persons going to jail. If all this costs more, then we should invest more resources up to the point at which additional resources purchase no more community safety or personal justice.

Studies we have seen suggest, however, that in many jurisdictions there is already a good deal of slack in the court system and that more cases could be heard, and for longer periods, without major new investments. Feeley found, in his study of Connecticut criminal courts, that the difference between busy and not-so-busy courts was not to be found in their sentences but in the fact that in busy courts, the judges work longer hours than in the not-so-busy ones. (Feeley.) Similarly, Gillespie's studies of circuit courts in Illinois and the federal court system suggest that on average excess capacity exists in both of these court systems. (Gillespie, 1973 and 1975.)

TECHNICAL APPENDIX

- A. Comparability of National Opinion Research Center and National Crime Survey crime rate estimates.
- B. Probability of arrest measurement error.
- C. Mathematical deviations of an incapacitation model by Ann G. T. Young, Harvard University

A. COMPARISON OF NATIONAL OPINION RESEARCH CENTER AND NATIONAL CRIME SURVEY CRIME RATE ESTIMATES

While both the NORC and NCS crime rate estimates are based on household victimization surveys of a representative sample of the national population, there are a number of differences in the technical methodologies which may bias comparisons between the two. For the type of comparison we are making (i.e., an estimate of the increase in crime rates between 1966 and 1973) the most important differences to be accounted for are those that would spuriously inflate an estimate of any observed increase. Several such differences do exist.

1) In the NORC initial screen questionnaire one person was asked to identify all crimes, personal and household, that occurred to all members of that household. Individual household members were then asked detailed questions about the personal crimes that happened to them and the household respondent answered detailed questions about household crimes. The NCS asks initial screen questions and detailed questions of all household members over 14 for personal crimes but still only one member for household crimes. It is possible that this difference may result in a substantial underestimate of the number of personal crimes in the NORC survey. For this reason we have limited our comparison in the text to the household crime of burglary.

2) The NORC survey used a twelve month reference period, while the NCS has a reference period of only 6 months. The 1966 survey asked persons to recall all crimes that occurred to them over the preceding year, but the 1973 survey asks persons to recall only crimes that occurred

within the past 6 months. The NCS (national sample) is a quarterly survey with a rotating sample so the Census Bureau is able to construct annual crime rate estimates with only a 6 month reference period (the NCS city samples use a 12 month reference period, however). If a longer reference period increases significantly the proportion of victimizations that persons forget to report to an interviewer, then again the NORC estimates could be biased downward.

Preliminary comparisons prepared by the Census Bureau between city sample data for New York City and national sample data for New York City (the size of NYC allows it to be separately identified in the national sample data) suggest that the discrepancies in the estimates of crime between the two different surveys are quite small. This does not prove that variation in reference periods has no effect on survey estimates of crime, as there are several other differences between the city and national data, but it does suggest that survey estimates of crime may be relatively insensitive to some dissimilarity in survey methodology.

3) The NORC survey imposed a limit of two incident reports per household member, while the NCS allows nine per person or 25 per household. It is possible but seems unlikely that the lower NORC limit would result in an underestimate of burglaries in 1966. Of all households reporting at least one victimization of any type in 1966 only 10 percent reported three or more for all household members combined. In addition, interviewers were instructed to exclude less serious crimes when multiple victimization was a problem.

4) In general the NCS questionnaire is a more precise, thorough, and carefully worded questionnaire than the one used in the earlier NORC survey. For example, the NCS burglary screen question includes illegal entry into

home/apartment, garage, or other building on respondent's property, while the NORC question is limited to home/apartment. Also, the NCS questionnaire includes a number of specific questions about the exact nature of the incident. The responses to these questions are the basis of an elaborate coding scheme that is used to determine if a burglary really did occur. The NORC survey asks only one open-ended question, about the details of the incident, which was hand coded to determine if a burglary or some other crime occurred. It is very difficult to judge the magnitude of these general differences on the NORC/NCS estimates. However, given the size of the apparent increase in burglary rates (i.e., by a factor of three) observed between the two surveys, it seems reasonable to conclude that a substantial increase in "real" crime rates did occur and that all of the increase cannot be dismissed as an artifact of the underlying methodologies.

B. Probability of arrest measurement error

Our first measure of policy activity is derived by dividing the number of robbery arrests in each city as reported by city police departments to the FBI (Uniform Crime Reports, appropriate years) by the number of robberies in that city as measured by the robberies reported by residents to the victimization survey. Both because of the way this variable is constructed and because of measurement problems in the number of arrests and the number of robberies it seems likely that it is to some extent a biased measure of police activity. In the text, we deal with this problem by developing an alternative measure of policy activity. Here we deal with these measurement problems directly.

The most serious source of bias results from the fact that the independent variable (probability of arrest) and the dependent variable (the crime rate) are both ratios with the number of robberies in the numerator of the dependent variable and the denominator of the independent variable. If the number of robberies is over - or under-estimated in some (not all) cities in the sample, the measured relationship between the independent and dependent variable includes spurious negative correlation. Since the theoretically predicted relationship between these two variables is negative, it is impossible to judge if a true negative relationship exists without an alternative measure of policy activity, or unless the magnitude of the measurement error can be estimated.

Careful analysis of the robbery victimization data suggests that data for certain cities in the sample of 26 may indeed represent an underestimate of the true number of robberies. The rate of trivial robberies (i.e., robberies where no injury occurs, no weapon is used, and the amount stolen is less than \$10) is almost three times higher in a low crime city

like Portland than in a high crime city like Detroit. Thus, one suspects that persons in Detroit exclude such minor incidents from account in the survey interviews, resulting in a smaller proportion of the true robbery rate being measured in Detroit than in Portland.

If the nature of this underreporting could be more precisely determined then it would be possible to mathematically estimate the size of the bias and subsequently derive an unbiased estimate of the probability of arrest coefficient. In the absence of such precise estimates, we must rely on the statistical significance of our alternative measure of police activity as an indication that a true negative relationship exists.

A second source of measurement error arises from the fact that the victimization survey interviews only residents of a city, whereas the police report arrests for all crimes that occur within a city whether the victim was a resident or non-resident. The probability of arrest will be biased to the extent that the distribution of arrests for resident and non-resident robberies (i.e., the distribution of arrests for robberies occurring in the city by whether the victim of the initial crime was a resident or a non-resident of the city) is non-proportional across cities. It seems reasonable to assume that the proportion of arrests for robberies committed against non-residents will be greater in those cities where the ratio of the transient population to the resident population is highest. Thus, in cities with relatively large transient populations the overstatement of the measure of arrests relative to the measure of crimes will be greater and the probability of arrest will be a more biased (upward) estimate of the true probability of arrest.

If the overstatement occurs where crime is low then the negative correlation we are observing between crime and the probability of arrest may simply be spurious correlation resulting from this bias. If the overstatement occurs where crime is high, the bias would tend to result in positive spurious correlation between crime and the probability of arrest. In this case, the negative correlation we are observing would be an underestimate of the true negative relationship. If the overstatement of the probability of arrest is not at all related to the level of crime, then the bias has the effect of obscuring any true relationship and the correlation and regression coefficients are biased toward zero. Again, in this case, the observed negative relationship would be an underestimate of the true negative relationship.

We have used proportion of the total SMSA population residing in the central city (CC/SMSA) as a crude measure of the relative extent to which non-resident populations move into and out of the central city. The lower the proportion living inside the central city the higher the ratio of the transient population to the resident population. Thus, cities with a low CC/SMSA are those where we would expect the probability of arrest to be overstated i.e., where a higher proportion of robbery arrests would be for robberies committed against non-residents. So we want to know if CC/SMSA for our 26 cities is positively, negatively, or not at all related to the robbery rate. The correlation coefficient between CC/SMSA and the total robbery rate for 22 of the cities (Oakland, San Francisco, Minneapolis, and Dallas were excluded because of dual central cities) is $- .053$, suggesting no relationship.

Assuming CC/SMSA is an adequate measure of the overstatement of the probability of arrest, we can conclude that the data are consistent with

the hypothesis that the bias in our estimate of the probability of arrest (due to the inclusion of arrest for robberies committed against non-residents) results in an underestimate of the true negative relationship between crime rates and the probability of arrest.

A third source of measurement error could arise from the fact that we count as robberies only personal victimizations but we use for arrest data police reports of total (personal and commercial) robbery arrests. There is no way to break down police arrest data by type of robbery committed. We have found no way to correct for this error and thus we cannot estimate whether the effect of counting reported robberies and arrested robberies differently tends to strengthen or weaken the observed negative relationship. The reader will have to bear in mind this source of uncertainty.

C. MATHEMATICAL DERIVATIONS OF AN INCAPACITATION MODEL
 BY ANN G. T. YOUNG, HARVARD UNIVERSITY
 (A Note on "A Simplified Model for Estimating the Effects
 of the Criminal Justice System on the Control of Crime,"
 Shlomo Shinnar and Reuel Shinnar.)

The following is a brief derivation and verification of the model in question.

Initial definitions and assumptions given in the paper:

q = probability an individual is caught and convicted
 J = probability an individual is sentenced to jail, given that he is convicted
 x = number of crimes committed by each individual during his career
 λ = number of crimes committed by each individual per year

Number of crimes:	POISSON	$\frac{e^{-\lambda} \lambda^k}{k!}$	mean = λ
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Length of sentence:	EXPONENTIAL	$\frac{1}{S} e^{-\frac{1}{S}t}$	mean = S
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Length of career:	EXPONENTIAL	$\frac{1}{T} e^{-\frac{1}{T}t}$	mean = T
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It is therefore the case that:

qJ = probability an individual is caught, convicted and sentenced to jail

Note that q, J, and qJ are each for a given crime, i.e. independent of previous record.

Probability jailed on the k^{th} crime (and not before):

GEOMETRIC	$(1 - qJ)^{k-1} (qJ)$	mean = $\frac{1}{qJ}$
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Time interval to the first crime (and therefore also interval between crimes):

EXPONENTIAL	$\lambda e^{-\lambda t}$	mean = $\frac{1}{\lambda}$
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Time interval to the k^{th} crime:

$$\text{GAMMA} \quad \frac{\lambda(\lambda t)^{k-1} e^{-\lambda t}}{(k-1)!} \quad \text{mean} = \frac{k}{\lambda}$$

Using means (expected values):

Expected time in jail on a given sentence = S

Expected time to first jailing (starting with t_0 = first crime):

$$\begin{aligned} \sum_{n=1}^{\infty} (1-qJ)^n (qJ) \frac{\lambda(\lambda t)^{n-1} e^{-\lambda t}}{(n-1)!} &= qJ(1-qJ)\lambda e^{-\lambda t} \sum_{n=1}^{\infty} (1-qJ)^{n-1} \frac{\lambda^{n-1} t^{n-1}}{(n-1)!} \\ &= qJ(1-qJ)\lambda e^{-\lambda t} e^{\lambda(1-qJ)t} = qJ(1-qJ)\lambda e^{-\lambda qJt} \\ &= (1-qJ)(\lambda qJ e^{-\lambda qJt}) \quad \text{EXPONENTIAL} \end{aligned}$$

$$\text{Therefore expected time} = \frac{1-qJ}{\lambda qJ}$$

Expected interval between jailings (starting with t_0 = end of jail sentence, assuming individual remains a criminal):

$$\sum_{n=1}^{\infty} (1-qJ)^{n-1} (qJ) \frac{\lambda(\lambda t)^{n-1} e^{-\lambda t}}{(n-1)!} = \lambda qJ e^{-\lambda qJt} \quad \text{EXPONENTIAL}$$

$$\text{Therefore expected interval} = \frac{1}{\lambda qJ}$$

Note that if start with t_0 prior to the first crime, this is also the expected time to first jailing.

$$\text{Expected number of crimes before jailed} = 1 + \frac{1-qJ}{qJ} = \frac{1}{qJ}$$

Assuming a career begins prior to the first crime and ends at the end of a sentence:

$$\text{Expected number of crimes} = x' = b \left(\frac{1}{qJ} \right) \quad \text{where } b = \text{expected number of jailings}$$

$$\text{Expected length of a career} = T = b \left(\frac{1}{\lambda qJ} + S \right)$$

Therefore expected number of jailings:

$$b = \frac{T}{\frac{1}{\lambda q J} + S} = \frac{\lambda q J T}{1 + \lambda q J S}$$

Therefore expected number of crimes:

$$x' = \left(\frac{\lambda q J T}{1 + \lambda q J S} \right) \left(\frac{1}{q J} \right) = \frac{\lambda T}{1 + \lambda q J S}$$

Therefore expected number of crimes averted through incarceration (a):

$$\frac{\lambda}{1} = \frac{a}{b S} \quad a = \lambda S \left(\frac{\lambda q J T}{1 + \lambda q J S} \right) = \frac{\lambda^2 q J T}{\frac{1}{S} + \lambda q J}$$

Expected time in jail:

$$b S = \frac{\lambda q J S T}{1 + \lambda q J S}$$

Expected time out of jail:

$$b \left(\frac{1}{\lambda q J} \right) = \frac{T}{1 + \lambda q J S}$$

New expected crime rate (for entire career):

$$\gamma = \frac{x'}{T} = \frac{\lambda}{1 + \lambda q J S}$$

Ratio of expected crime rate to new crime rate:

$$\frac{\lambda}{\gamma} = 1 + \lambda q J S$$

Expected proportion of crimes which actually take place:

$$\frac{x'}{x} = \frac{1}{1 + \lambda q J S}$$

Expected proportion of crimes prevented:

$$\frac{x - x'}{x} = \frac{\lambda q J S}{1 + \lambda q J S}$$

Proportion reduction in crimes and proportion reduction in crime rate:

$$\frac{\lambda - \gamma}{\lambda} = \frac{x - x'}{x} = \frac{\lambda qJS}{1 + \lambda qJS} = \frac{\lambda qJ}{\frac{1}{S} + \lambda qJ}$$

Note that this reduction is over the expected crime rate (λ),
i.e. the case where there are no jail sentences.

Proportion reduction in crime rate due to increased sentence length:

$$\frac{\gamma_1 - \gamma_2}{\gamma_1} = \frac{\frac{\lambda}{1 + \lambda qJS_1} - \frac{\lambda}{1 + \lambda qJS_2}}{\frac{\lambda}{1 + \lambda qJS_1}} = \frac{\lambda qJ(S_2 - S_1)}{1 + \lambda qJS_2}$$

END

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